

Estimation of phosphate ion in the waters of the rivers of the Baltic catchment (on the example of the Western Bug River)

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1. Introduction

Features of the Baltic Sea: shallow water, low salinity of sea water, difficult water exchange with the North Sea, which lead to low self-cleaning ability with an average time of complete water exchange of about 30-50 years and high sensitivity to anthropogenic effects from developed industrial and agricultural regions located on catchment of the sea, Lass et al (2008). According to HELCOM, today more than 97% of the Baltic Sea region suffers from eutrophication due to past and present excessive amounts of nitrogen and phosphorus, HELCOM et al (2018) [2].

The greatest influence on the transformation of the hydrochemical regime of the Baltic Sea water is provided by countries whose rivers flow into this sea. So 83 800 km² of Belarus is located within the Baltic Sea basin. As mentioned earlier, the main pollutants are nitrogen and phosphorus-containing substances. The current annual total supply of nutrients to the Baltic Sea is about 826 000 and 30 900 tons of nitrogen and phosphorus, respectively, which mainly form river flows, HELCOM et al (2018).

The Western Bug is a typical transboundary (Belarus, Poland and Ukraine) river on the southern slope of the Baltic Sea. The catchment of the river is 73 470 km². In Belarus, the length of the river is 154 km.

2. Initial data and research methods

Hydrochemical analysis of water The Western Bug was based on data from the State Water Cadastre of the Republic of Belarus for the period from 2004 to 2018, for 6 hydrochemical gauges, Water resources et al (2018). To assess the temporal structure of the series of phosphate ions, standard statistical methods were used.

The aim of this work is to identify patterns in the fluctuations in time of the phosphate ion on the example of the Western Bug River.

3. The results obtained and their discussion

Currently, the Western Bug is experiencing a large load in terms of phosphate-ion. In all the observed sections, maximum permissible concentrations (MPC) (0.066 mgP/dm³) were exceeded. It should be noted that the maximum permissible concentration is observed in the first section on the territory of Belarus (for example, Tomashovka).

Table Statistical parameters of the phosphate-ion in the river Western Bug, mgP/dm³.

	value			odds			
	average	minimum	maximum	variations	asymmetries	gradient change	correlations
s. Tomashovka	0.155	0.116	0.217	0.22	0.42	-0.044	-0.61
s. Domachevo	0.155	0.120	0.186	0.15	-0.28	-0.009	-0.14
s. Rechitsa	0.182	0.118	0.220	0.18	-0.77	-0.026	-0.40
c. Brest Kozlovichi bridge	0.180	0.150	0.225	0.14	0.64	-0.024	-0.40
0.1 km west of s. Terebun	0.162	0.130	0.190	0.12	-0.52	-0.026	-0.49
s. Novoselki	0.152	0.089	0.180	0.20	-1.26	-0.044	-0.70

The reason for this is the mass transfer of phosphate-ion from the territory of Ukraine. The location on the river of the regional center - the city of Brest - also affects the increase in the content of phosphate-ion, but to a lesser extent, on average, this increase is 0.027 mgP/dm³. It should be noted that the situation is stabilizing, as evidenced by the following data. So in 2018, as a result of environmental measures, a decrease in the content of phosphate-ion in river water occurred. The difference between the Tomashovka and Novoselki alignments was 0.033 mgP/dm³. This is also evidenced by the amount of phosphate-ion discharges into the basin of the Western Bug River (Fig.).

The main statistical parameters of the time series of the phosphate ion for all the sections under consideration are given in the table.

As can be seen from the table, everywhere there is a tendency to a decrease in phosphate-ion. This is especially pronounced in the Tomashovka and Novoselki sections, which indicates the significance of the correlation coefficients of linear trends (Table 1). The coefficient of variation indicates the average degree of dispersion of the considered parameter.

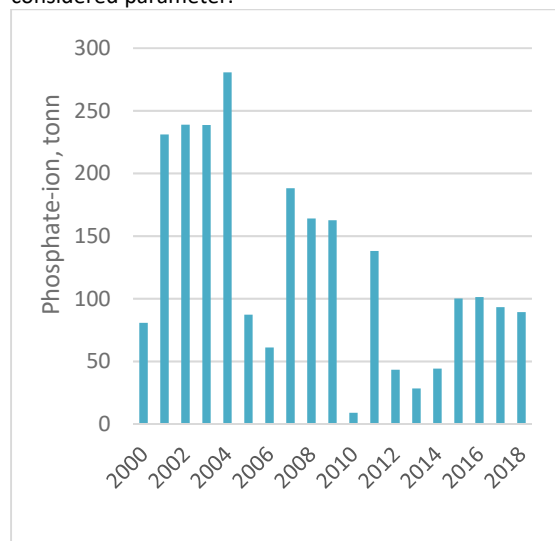


Figure 1. Dynamics of phosphate ion collection into the Western Bug River basin in Belarus

A quantitative assessment of the fluctuations of the phosphate ion is estimated as the gradient of change, which is multiplied by 10 years, i.e. $\alpha = a10$ years

4. Conclusion

The influence of river waters on the formation of the hydrochemical regime of the Baltic Sea is undeniable, and the waters of the Western Bug River are no exception. The river basin is under heavy pressure in terms of phosphate ion. The average annual indicators of this parameter for 2018 exceed the MPC in all observed sections by 1.4 - 1.8 times. It is also worth noting the positive aspects. A decrease in the discharge of phosphate ion into the Western Bug basin affects the trend in the content of this component in river waters. It was noted that the tendency to a decrease in phosphate ion is observed at all sections, however, only two are significant. This indicates a positive direction of measures taken to preserve and protect the environment.

References

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